

Atty. Docket No. 2001-0093-01
 USSN 09/896,689

Amendments to the Specification:

Please amend the specification as follows:

Please replace paragraph [0019] with the following amended paragraph:

[0019] Thus, according to one aspect of the invention, a system is provided to govern the behavior of a controller used to dictate motion of a machine component. The system includes a sensor that measures data that accurately characterizes the physical behavior of the component. The sensor takes its data reading when the component is not in normal use. The system also includes a processor which dynamically generates a mathematical relation which is multivariable and fully coupled and of minimal order based upon which the controller dictates component motion when the component is in normal use.

Please replace paragraph [0042] with the following amended paragraph:

[0042] Additionally, this approach to tuning can be used to adjust the controller directly from the measured data, without performing system ID. In this case, key controller parameters are explicitly made functions of the measured response.

$$\theta_c = H(G_{ij}(f_k), i = 1 \dots p, j = 1 \dots q, k = 1 \dots N)$$

By way of example, this final case of tuning could be useful for updating or tuning positive position feedback (PPF) compensators in which the goal of the controller is to damp out vibration in a piece of manufacturing equipment. Thus according to aspects of an embodiment of the present invention there is disclosed a method of creating a controller of the type employed by a user to govern motion in a physical system comprising the steps of: generating an identification of the system by measuring the response of the system to commands; accepting input from the user specifying certain parameters of the system; applying a universal filter to the input from the user to create a user-defined behavioral range for the physical system; creating a problem specification from the identification of the system and the behavioral range; and solving the problem specification, thereby creating the controller.

BEST AVAILABLE COPY

Atty. Docket No. 2001-0093-01
USSN 09/896,689

Please replace paragraph [0043] with the following amended paragraph:

[0043] FIG. 1 shows a schematic illustration of a control system 80 according to the invention in which tuning is implemented. In normal mode, a switch 10 selects an output 12 of a controller 21 (typically a computer processor) as an input 13 to a plant 20 ("plant" being used herein as a generic term for the system being controlled, such as manufacturing equipment). When the system 80 is switched to tuning mode, the plant input 13 is switched to a function generator 15. Signals going into the plant, i.e., plant input 13, and coming out of the plant, i.e. plant output 17 (from sensors in the plant), including the addition of any system disturbances 9, are analyzed and an internal model of the system is updated to reflect the new data. Model estimation 18 is passed to a tuning algorithm 19, which adjusts or tunes the controller 21 to maximize stability and performance. The updated, or tuned, controller parameters are then installed or written into the controller 21 at, for example, an electronic memory location. Then, the switch 10 is toggled to begin controlling the system in normal operation. As explained above, a first controller 21 based upon a first mathematical model is updated to form a second mathematical model from which a second controller 21 is formed, which second controller is then placed back into the control loop for the system/plant under the control of the controller 21. Thereby, motion induced when a second signal is applied to the mechanical apparatus is well-predicted.

Please replace paragraph [0044] with the following amended paragraph:

[0044] FIG. 2 adds detail to the plant, in this case, manufacturing equipment 20, and shows a procedure by which control parameters can be updated for manufacturing equipment 20, where equipment 20 is shown as including sensor(s) 25, actuators or motor(s) 23 and manufacturing equipment 24. In this embodiment, an event 51 occurs which causes the system to switch the controller 21 into data acquisition mode 52. Events 51 that might initiate this change include a command generated by an operator, a command generated as a result of a clock in communication with the system, or a change in the performance of the system. The clock may be used to generate the above noted command after the passage of a selected (predetermined) time period, and

Atty. Docket No. 2001-0093-01
USSN 09/896,689

the change in the performance of the system may be measured against an operating value of the system exceeding a selected (predetermined) threshold. In this embodiment, when the controller 21 is placed into data acquisition mode, it generates a drive signal that is applied to amplifier(s) 22, which then applies a signal to the actuators/motors 23. The actuators/motors 23 command some motion or action in the manufacturing equipment 24. The motion of action results in the sensor(s) 25 generating at least one sensor signal that is at least partly responsive to, or indicative of, the motion or action generated by the actuators 23 on the manufacturing equipment 24. The sensor signal is then conditioned by signal conditioner 26 and passed back to the controller 21. At this point, the controller 21 would follow the procedure illustrated in FIG. 5 following the point in which the system acquires new data in data acquisition mode 53.

Please replace paragraph [0045] with the following amended paragraph:

[0045] FIG. 3 shows an alternative procedure by which control parameters can be updated for a system or plant 20. In this embodiment, an event 51 occurs which causes the system to switch the secondary processor (or a host personal computer PC) 27 into data acquisition mode 52. Events 51 that might initiate this change include a command generated by an operator, a command generated as a result of a clock in communication with the system, or a change in the performance of the system. In this embodiment, when the secondary processor 27 is placed into data acquisition mode it generates at least one signal that is applied to amplifier(s) 22, which then applies at least one signal to the actuators or motors 23. The actuators or motors 23 command some motion or action in the manufacturing equipment 24. The motion or action results in the sensor(s) 25 generating at least one sensor signal that is at least partly responsive to the motion or action generated by the actuators 23 upon the manufacturing equipment 24. The sensor signal is then conditioned and passed back to the processor 27. At this point, the processor 27 would follow the procedure illustrated in FIG. 5 following the point at which the system acquires new data in data acquisition mode 53. Once the new controller or control parameters, 55 or 56, are created according to FIG. 5, secondary processor 27 would write or install the controller or control parameters into processor 21. The system

Atty. Docket No. 2001-0093-01
USSN 09/896,689

would then switch into controller mode 58. The secondary processor may be portable from the location of the system processor.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.